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(19) (CA) **CANADIAN PATENT** (12)

(54) ROTARY JOINT

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**Canada**

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1.           Rotary joints are utilized to establish communication  
2. between a fixed conduit system and a rotating member, such as a  
3. heating or cooling drum. The joint includes a housing having a  
4. chamber defined therein having a port for communicating with a  
5. fixed conduit system, and a rotary member, such as a sleeve or  
6. nipple, is located within the housing and supported thereon by  
7. bearings. Sealing means establish fluid tight seals between the  
8. housing and the rotatable sleeve, and the sleeve is coaxially  
9. aligned with the rotating member being serviced. With rotary  
10. joints, the life and efficiency is related to the ability of the  
11. seal to remain efficient and operative, and a wide variety of  
12. sealing arrangements have been employed with rotary joints.

13.           While rotary joints utilize both friction and anti-  
14. friction bearings, it is highly desirable in many applications to  
15. employ anti-friction bearings, and in such joints it is the prac-  
16. tice to use a pair of ball bearings mounted upon a tubular sleeve  
17. axially spaced relative to each other in order to assure concen-  
18. tricity of the sleeve to the bearing and housing during operation.  
19. The use of a pair of ball bearings is expensive, but it is the  
20. common practice to use the bearings in pairs in order to achieve  
21. axial rigidity and prevent misalignment which would adversely af-  
22. fect the sealing as provided by known rotary joint seal assemblies.

23.           From a cost standpoint, it is preferable to use only  
24. a single anti-friction bearing in a rotary joint. However, dif-  
25. ficulties encountered with respect to maintaining alignment be-  
26. tween the rotary and stationary components with attendant pro-  
27. blems of maintaining seal integrity render single anti-friction  
28. bearing joints usable in only relatively few applications, and  
29. floating seals are sometimes used which have self-aligning capa-  
30. bilities.

31.           It is an object of the invention to provide a rotary  
32. joint utilizing a single anti-friction bearing between static and



1. and dynamic components, and wherein self-aligning sealing apparatus is employed which is of an economical construction, and may  
2. be readily installed.

4. An additional object of the invention is to provide  
5. a rotary joint employing a single anti-friction bearing wherein  
6. a floating and self-compensating seal assembly is used which  
7. automatically accommodates itself to misalignment with respect  
8. to the axis of joint rotation, and wherein wear is automatically  
9. compensated for by means of biasing structure.

10. Yet an additional object of the invention is to provide  
11. vide a rotary joint utilizing a single anti-friction bearing  
12. wherein the bearing supports a rotating sleeve received within  
13. the bearing inner race, and an adapter removably affixed to the  
14. sleeve laterally engages the inner bearing race locating and  
15. positively retaining the sleeve within the inner bearing race.

16. Additionally, an object of the invention pertains to  
17. rotary joint structure wherein an economical joint may be produced having a relatively wide range of self-alignment, and  
18. wherein a variety of conduit attaching adapters associated with  
19. an inner sleeve may be selectively mounted upon the sleeve, and  
20. wherein the adapter aids in maintaining the sleeve in operative  
21. relationship with anti-friction bearing means.

23. In the practice of the invention a housing includes  
24. a chamber defined therein communicating with at least one port  
25. associated with a fluid supply or discharge conduit. A single  
26. anti-friction ball bearing is mounted within the housing chamber  
27. and a tubular sleeve is located within the bearing inner race  
28. and positively associated therewith by a threaded adapter mounted  
29. upon the sleeve and engaging a lateral side of the inner bearing  
30. race.

31. A seal assembly is interposed between the sleeve and  
32. the housing having a sealing surface which lies in a plane sub-

1. substantially perpendicular to the sleeve axis of rotation, and the  
2. sealing assembly includes an annular sealing surface against which  
3. an annular seal ring is biased by a compression spring. The seal  
4. ring is maintained in place by a resilient elastomer support ring  
5. slidably supported within the housing, and this resilient support  
6. ring permits the seal ring to compensate for deviation of the  
7. sealing surface from the true axis of rotation, the elastomer per-  
8. mitting the seal ring to maintain a sealing relationship with the  
9. sealing surface defined on the sleeve, and the spring insuring an  
10. effective seal between the seal ring and sealing surface regard-  
11. less of whether the rotation of the sleeve is true.

12. A radially extending shoulder is defined upon the  
13. sleeve adapted to engage a lateral edge of the inner bearing ring,  
14. and a conduit adapter threaded upon the sleeve engages the opposite  
15. bearing inner race lateral edge whereby threading the adapter upon  
16. the sleeve positively locks and positions the sleeve relative to  
17. the bearing inner race. The adapter may take any desired form,  
18. such as male threaded, female threaded, or the like, and the en-  
19. tire rotary joint apparatus is of an economical construction  
20. which may be readily manufactured by high production techniques.

21. The aforementioned objects and advantages of the in-  
22. vention will be appreciated from the following description and  
23. accompanying drawings wherein:

24. Fig. 1 is a diametrical, elevational, sectional  
25. view of a rotary joint in accord with the invention,

26. Fig. 2 is an enlarged, detail, diametrical, eleva-  
27. tional, sectional view of the seal assembly,

28. Fig. 3 is a detail, elevational, sectional diametri-  
29. cal view of the rotary joint illustrating another embodiment of  
30. adapter, and

31. Fig. 4 is an enlarged, detail, elevational sectional  
32. view of a modification of seal assembly for use within high pres-

1. sure installations.

2. With reference to Figs. 1 and 2, a rotary joint in  
3. accord with the invention includes a housing 10 which may be  
4. formed of either metal or synthetic plastic. The housing in-  
5. cludes a passage 12 communicating with threaded ports 14 and 16,  
6. and if desired one of these ports may be plugged, or conduits  
7. associated therewith, not shown.

8. A chamber 18 is defined within the housing 10 and  
9. is vented through vents 20. The chamber 18 includes a radial  
10. shoulder 22 intersecting cylindrical surface 24, and a cylindrical  
11. surface 26 intersecting radial shoulder 28 defines a bearing re-  
12. ceiving recess into which anti-friction ball bearing 30 is  
13. mounted. A recess 32 receives a split retaining ring 34 engaging  
14. a lateral side of the bearing outer race 36 whereby axial dis-  
15. placement of the bearing relative to the housing 10 is prevented.

16. A tubular sleeve 38 includes a cylindrical surface  
17. closely received within the bearing inner race 40. Sleeve 38  
18. includes a radial shoulder 42 engaged by one lateral side of the  
19. inner race 40.

20. The sleeve 38 includes a recess 44 adapted to receive  
21. a portion of the seal assembly 46, and at the opposite end of the  
22. sleeve external threads 48 are defined upon which the adapter 50  
23. is threaded.

24. The adapter 50 is of a tubular configuration having  
25. internal threads which mate with the sleeve threads 48, and the  
26. end 52 of the adapter engages a lateral side of the bearing inner  
27. race 40 forcing the inner race against the sleeve shoulder 42  
28. thereby firmly mounting the sleeve to the inner race. The adapter  
29. shown in Fig. 1 is externally threaded at 54 whereby the adapter  
30. may be threaded into an opening or a pipe coupling, not shown,  
31. for association with drum related structure, or the like.

32. The rotary joint seal assembly generally indicated

1. at 46 includes an annular elastic cushion 56 which is received  
2. within the sleeve recess 44. The cushion 56, in turn, includes  
3. a recess in which the annular circular seal element 58 is mounted  
4. having a flat sealing surface 60 defined thereon which lies in a  
5. plane perpendicularly disposed to the axis of the bearing 30 and  
6. sleeve 38. The element 58 may be formed of ceramic, iron or  
7. stainless steel.

8. A seal ring 62, which may be formed of synthetic  
9. plastic or carbon, includes an annular projection 64 defining  
10. a flat sealing surface 66 sealingly engaging the seal surface  
11. 60. The seal ring 62 includes an axially extending cylindrical  
12. surface 68 which intersects the radial surface 70, and these two  
13. surfaces define a recess in which the annular static seal support  
14. member 72 is received. The support member 72 is formed of an  
15. elastic material and includes an outer cylindrical surface 74  
16. which closely engages the housing cylindrical surface 24 in a  
17. frictional yet axially slid able, relationship. The support mem-  
18. ber 72 is provided with a tapered surface 76 defining a lip 78,  
19. and likewise the portion 80 constitutes a lip whereby pressure  
20. within the housing will force the lips against the support sur-  
21. faces 24 and 68 to produce fluid-tight seals therewith.

22. The support member 72 includes a radially extending  
23. surface 82 against which the collar 84 of a spring assembly en-  
24. gages. A similar collar 86 engages the housing surface 22, and  
25. compression spring 88 imposed between the collars will produce a  
26. biasing force on the support member 72 and seal ring 62 toward  
27. the right, Fig. 1, which is substantially uniformly distributed  
28. about the configuration of the elastic support member 72.

29. In use, the adapter 50 is threaded into the drum or  
30. other rotating part to which pressurized fluid medium is supplied,  
31. or withdrawn, and supply or exhaust conduits are threaded into  
32. the port or ports 14 or 16 of the housing 10. As the sleeve 38

1. rotates relative to the housing 10 the seal ring 62 will maintain  
2. a sealed relationship with the sealing surface 60 due to the  
3. flexible support of the seal ring provided by an elastomeric sup-  
4. port member 72. Assuming that a pressurized fluid is being trans-  
5. mitted through the rotary joint, the fluid pressure exerted upon  
6. the support member 72 will cause the support member and seal ring  
7. 62 to function as a piston maintaining the seal ring in firm en-  
8. gagement with the seal surface 60, and if the sleeve 38 is slightly  
9. out of alignment with the axis of the bearing 30 the nutating ac-  
10. tion of the seal ring 62 will be compensated for by the ability  
11. of the seal ring to follow such erratic movement of the sealing  
12. surface 60 because of the elastomeric character of support member  
13. 72.

14. The presence of the spring 88, and associated collars,  
15. assures that a tight sealing engagement between the seal ring 62  
16. and sealing surface 60 occurs even when the rotary joint is not  
17. under pressure, or if a subatmospheric pressure exists within the  
18. rotary joint. The frictional engagement of the support member 72  
19. to the surface 24 eliminates the need for pins or keys to prevent  
20. relative rotation, and the seal assembly components are of a sim-  
21. ple form which may be readily manufactured commercially at little  
22. cost.

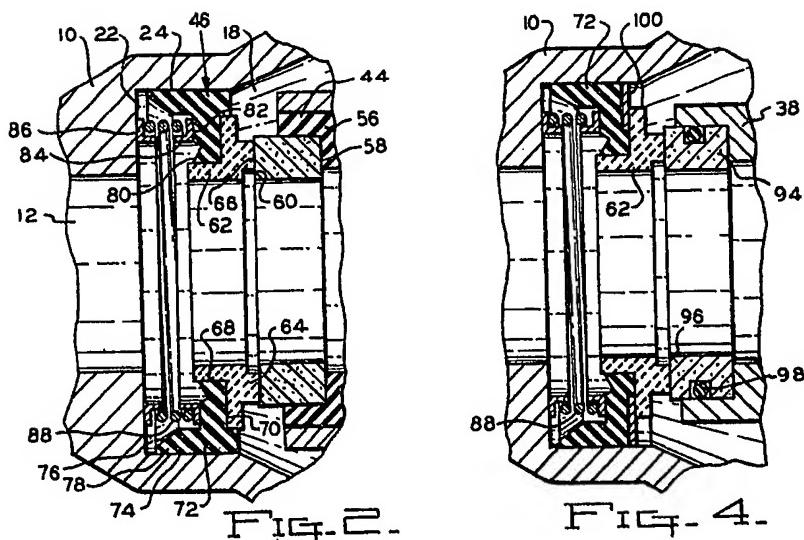
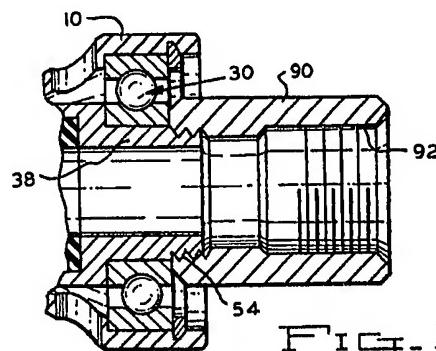
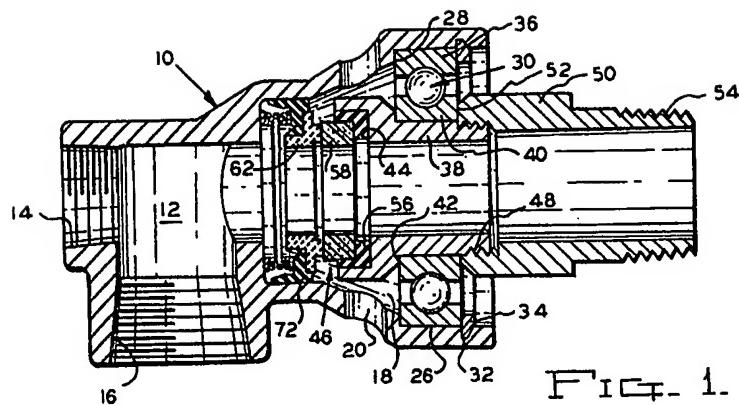
23. In Fig. 3 a modification of tubular adapter 90 is  
24. illustrated having internal threads 92 for threading upon the  
25. sleeve 38 as described above. However, the adapter 90 is inter-  
26. nally threaded for eliminating the need for a coupling.

27. In Fig. 4 a variation of seal assembly is shown which  
28. is particularly suitable where very high pressures are transmitted  
29. through the rotary joint. In Fig. 4, the annular element 94 de-  
30. fining sealing surface 96 is not mounted within a resilient cushion,  
31. but an O-ring 98 is used to prevent the escape of fluid from around  
32. the element. Additionally, a rigid washer 100 formed of metal, or

1. the like, is located as illustrated, and may be either embedded
2. in the support member 72 or the support member 72 may be recessed
3. to accommodate the same. The presence of the washer 100 pre-
4. vents the elastic material of the support member from being
5. "extruded" past the seal ring 62.

6. It will be appreciated from the aforescribed description that the invention results in a low cost rotary joint of simplified construction wherein a single anti-friction bearing may be employed, and yet dependable and long wearing high sealing efficiencies can be maintained.

11. It is appreciated that various modifications to the inventive concepts may be apparent to those skilled in the art without departing from the spirit and scope of the invention.



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The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. 1. A rotary joint comprising, in combination,
2. 2. an annular housing having a first port in communication
3. 3. with a chamber defined therein, a single annular anti-
4. 4. friction bearing mounted upon said housing within said
5. 5. chamber, a tubular sleeve mounted within said bearing for
6. 6. rotation within said chamber about an axis, a second port
7. 7. defined by said sleeve communicating with said chamber, an
8. 8. annular elastic cushion mounted on said sleeve adjacent
9. 9. said second port, an annular rigid seal element supported
10. 10. upon said cushion defining an annular radially disposed
11. 11. sealing surface defined on said sleeve concentric with said
12. 12. axis, an annular seal within said chamber concentric with
13. 13. said axis sealingly and slidably engaging said sealing sur-
14. 14. face, annular resilient seal support means sealed with re-
15. 15. spect to said housing flexibly supporting said annular seal
16. 16. and constituting the sole support of said seal whereby said
17. 17. seal is self-aligning with respect to said sealing surface,
18. 18. a cylindrical surface defined in said chamber coaxial to
19. 19. said axis, said seal support means comprising an elastomeric
20. 20. ring having a first lip seal portion sealingly engaging said
21. 21. cylindrical surface, a cylindrical surface defined on said
22. 22. annular seal coaxial to said axis, said ring having a second
23. 23. lip portion engaging said seal cylindrical surface wherein
24. 24. said seal is supported within said ring, fluid pressure within
25. 25. said housing biasing said seal into engagement with said
26. 26. sealing surface and said lip seals into sealing relation to
27. 27. to their associated cylindrical surface.

1. 2. In a rotary joint as in claim 1, a spring  
2. within said chamber engaging said ring axially biasing  
3. said ring and seal toward said sealing surface.

1. 3. In a rotary joint as in claim 1, an annular  
2. adapter releasably affixed to said sleeve in communication  
3. with said second port, and conduit attachment means defined  
4. on said adapter.

1. 4. In a rotary joint as in claim 3, an annular  
2. thread defined on said sleeve, said bearing including an  
3. inner race engaging a radial shoulder defined on said sleeve,  
4. threads defined on said adapter for mating with said sleeve  
5. threads, said adapter engaging said bearing inner race af-  
6. fixing said inner race to said sleeve.

1. 5. In a rotary joint as in claim 1, an anti-  
2. extrusion rigid ring located between said seal and said  
3. elastomer ring to prevent extrusion of said elastomer due  
4. to the pressure within said housing.



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ABSTRACT

A SEALED FLUID SWIVEL JOINT

A seal arrangement for a fluid swivel joint such, as is commonly used on offshore loading terminals for tankers, includes first and second adjacent joint rings 30, 32 which are rotatable relative to each other about a common central longitudinal axis. The joint rings 30, 32 have a small annular clearance gap 34 therebetween to allow relative rotational movement, and one of the rings includes an annular seal housing groove 42 communicating with the clearance gap 34. An annular seal is positioned in the seal housing groove 42, and includes a pliant annular, sealing member 44 and an adjacent free-floating anti-extrusion ring 46 to prevent the pliant sealing member 44 from being deformed into the clearance gap by a relatively high fluid pressure differential existing across the seal. An oil injection system circulates a flow of oil between a sealing face on one of the joint rings 30 and the contacting surfaces of the sealing member 44 and anti-extrusion 46 so as to remove generated heat and any seal wear debris from the seal arrangement.